Foreign Firms and Host-Country Productivity: Does the Mode of Entry Matter?*

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Abstract

Foreign direct investment is considered an important source of knowledge spillovers. We argue that the effects of foreign presence on host country productivity may differ depending on the mode of foreign entry. Using a long panel from the Norwegian Manufacturing Census, we find that greenfield entry both in the same industry and in the same labour market region has a negative impact on the productivity of domestic plants, while entry via acquisition affects the productivity of domestic plants in the same industry positively. The positive effect from acquisitions is consistent with knowledge spillovers as these plants have pre-established linkages within the industry. The negative effects from greenfield entry can be attributed to increased competition both in the product market and for qualified employees in a tight labour market. This may help to explain the ambiguity of results in the empirical literature that relates overall foreign presence to host country productivity.

Keywords: mode of foreign entry, productivity, competition, spillovers

JEL Classification: D24, L1, F21

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1 Introduction

The increase in foreign-direct investment (FDI) over the past 25 years has been one of the main features of globalisation. Foreign direct investment stock as a share of world gross domestic product increased from 5% in 1982 to nearly 26% in 2006. At least since the mid-1990s cross-border mergers and acquisitions (M&As) have become the most important component of FDI; in 2006 cross-border M&As accounted for over 70% of worldwide FDI outflows (UNCTAD 2007, p.9). Caves (1974) was first to note that foreign direct investment creates a potential both for the diffusion of advanced technological and organisational knowledge to host country firms as well as for increased competition in host countries. Both effects have the potential to raise the productivity of domestic plants; however, Görg and Greenaway (2004) in their survey of the literature find the evidence on the existence and sign of spillovers from foreign-owned to local firms in narrowly defined industries to be inconclusive.1 A possible explanation for this ambiguity of results is that FDI is not a homogenous phenomenon. The potential for spillovers to arise depends on both the capacity of domestic plants to absorb them as well as on the potential of the foreign multinationals to generate spillovers. Previous studies asking whether heterogeneity in FDI matters for spillovers have for example split FDI according to the degree of foreign ownership (Blomström and Sjöholm, 1999; Dimelis and Louri, 2001; Smarzynska Javorcik and Spatareanu, 2008), the motivation for FDI (Driffield and Love, 2006), and different characteristics of the foreign affiliates (Castellani and Zanfei, 2006).

We investigate whether the mode of entry of foreign-owned firms matters for productivity spillovers to domestic firms. For foreign investors it is an important strategic choice whether to enter a new market via greenfield investment or through acquisition of assets in the host country. This choice also affects market structure in the host country differently: greenfield entry adds production capacity while acquisition entry only changes ownership and control over existing assets. In addition, given the different degrees to which greenfield and acquisition ventures are embedded in the local economy around the time of entry, the two entry modes

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1 Among the more recent studies, Aitken and Harrison (1999) find a negative effect for Venezuela, as do Konings (2001) for Poland, Bulgaria and Romania, and Djankov and Hoenckman (2000) for the Czech republic. On the other hand Haskel et al. (2007) and Keller and Yeaple (2009) find evidence of positive spillovers for the UK and the US, respectively.
may have different effects on the domestic firms in the same sector or region. As noted above a large share of FDI takes the form of cross-border mergers and acquisitions and most countries receive FDI through both modes of entry. Therefore, combining these two modes of entry into a single measure of foreign presence in the sector, as is common in the literature, may give rise to ambiguous results. We estimate production functions for the domestic plants augmented by terms that capture foreign presence in the same sector and in the same region in order to compare our results to the existing literature. We then go one step further and split this measure of overall foreign presence into three terms, two separate terms for the new foreign entrants differentiated by the mode of entry and another term for the existing foreign-owned firms. By doing this we can explicitly account for the effects of foreign entry through acquisitions and greenfield investment. In addition, we can investigate whether the extent of spillovers from recent foreign entrants and previously established foreign-owned firms are different.

We use a large panel based on 24 years of the full census of Norwegian manufacturing plants for the period 1978-2001. In addition, we have plant-level information on foreign ownership. As the census captures all plants in Norwegian manufacturing, our results are not affected by the sampling issues that most other work in this area is burdened with. The census-nature of the data allows us to identify foreign entry with a high degree of precision. The employment share in foreign-owned firms in Norwegian manufacturing increased from about 6.5% in 1978 to 25% in 2001. In contrast to many other developed economies Norway has not introduced specific incentive schemes in order to attract foreign direct investment.\(^2\) Over the long sample period Norway has seen sufficient episodes of greenfield investment and foreign acquisitions to make it an ideal case for studying the effects of the two modes of entry on the productivity of domestic plants in the same industry.

We estimate augmented production functions for domestic plants where output is regressed on inputs, measures of foreign presence and the mode of foreign entry at both the industry and

\(^2\)In 1994 an organisation called ‘Invest in Norway’ was set up as a separate office of the existing ‘Norwegian Industrial and Regional Development Fund’ (SND). The aim of SND (replaced by Innovation Norway in 2004) is to stimulate business development in all parts of Norway. In line with this ‘Invest in Norway’ was to promote the establishment of foreign firms in Norway, but it had no separate subsidy or incentive schemes for this purpose. The office worked mainly towards marketing Norway as a country to invest in and provided information to interested investors. ‘Invest in Norway’ was closed down by the end of the 1990s (see SND’s annual reports 1993-1999).
regional level, as well as control variables for the intensity of competition. Our results suggest that a change in foreign presence measured as the change in the share of overall employment in foreign-owned plants relative to total employment in a sector, has a small positive effect on the productivity of domestic firms. When we specifically account for the change in foreign presence in the same industry due to both greenfield entry and foreign acquisitions, we find opposite effects of the two modes of entry. The impact of greenfield entry on domestic productivity is negative; a 10 percentage point increase in greenfield entry last year implies a 1.9% reduction in total factor productivity (TFP) of the domestic firms in the same sector and a 3.8% reduction in productivity in the same labour market region. In contrast, a 10 percentage point increase in the rate of acquisitions raises the TFP of the domestic plants in that sector by 0.8%. Our finding of opposite effects of greenfield and acquisition entry apply to majority-owned foreign entry. They are robust to concerns regarding selection, measurement and endogeneity. We argue that the positive effect of foreign acquisitions on the productivity of domestic plants is consistent with spillovers from foreign-owned plants through knowledge diffusion and positive competition effects. The negative effect of greenfield foreign entry seems to be the result of a market stealing effect in the product market in combination with competition for key employees in a relatively tight labour market.

The remainder of this paper is structured as follows. In Section 2 we lay out the theoretical and empirical background and derive conjectures about the implications of greenfield and acquisition entry. In Section 3 we discuss our strategy for estimating the impact from greenfield entry and entry by acquisition on the productivity of domestic firms. In Section 4 we describe the data sources and give an overview of the development of foreign ownership and foreign entry in Norwegian manufacturing. We present our estimation results and examine their robustness to a number of different specifications in Section 5. Section 6 provides a discussion of our results; and Section 7 briefly concludes.

2 Mode of entry and implications for host country firms

The implications of firm entry for incumbent firms, their performance and market structure have long attracted the interest of researchers, see Geroski (1995), Siegfried and Evans (1995)
and Caves (1998) for surveys. This literature has not distinguished between foreign and domestic entry, and relates primarily to domestic entry. In general the findings show that most entrants are small, have a low chance of survival, and make only small contributions to industry productivity growth, but the entry-exit process is important for longer term industry-level productivity gains. A substantial literature has established that foreign entrants are different: they are larger, more technology intensive and more productive than their host-county competitors (e.g. Barba Navaretti and Venables, 2004).

Caves (1974) postulated that foreign direct investment may affect host country firms in two ways. First, by endowing their subsidiaries with skilled entrepreneurship and/or productive knowledge, foreign multinationals may generate spillovers to host country firms. Second, the presence of efficient foreign subsidiaries may also increase competition in the host country. The effects from foreign presence are likely to be felt strongest by host country competitors in the first few years after entry. Moreover, there are several indications to suggest that these effects differ depending on whether the foreign subsidiary was established through greenfield entry or via acquisition of an existing plant. This applies to both the potential for knowledge diffusion as well as the potential for increased competitive pressure. We discuss the implications for each channel in turn.

Both types of foreign entry are likely to create potential for knowledge diffusion by enhancing the existing knowledge stock in the host country with superior technology or organisational skills from their headquarters abroad. In the theoretical literature on the choice between greenfield entry and entry via acquisition it is always the most efficient firms that choose the greenfield route (e.g. Mattoo et al. 2004, Nocke and Yeaple 2007, Norbäck and Persson 2008, Haller 2009). Broadly speaking, this is because they do not have to share the profits with a local partner as greenfield investors. Javorcik and Saggi (forthc.) provide evidence for Eastern European countries showing that greenfield entrants are more productive that acquisition entrants. Evidence presented in Balsvik and Haller (forthc.) also suggests that foreign greenfield entrants have higher productivity than acquisition entrants in Norwegian manufacturing. If this is generally the case, the potential for knowledge diffusion may be larger from greenfield entrants than from foreign acquisitions. Yet the efficient foreign entrants will
also have the largest incentives to protect their intellectual property, therefore actual knowledge diffusion from these plants to competitors may be small.

A growing literature on the ownership advantages of foreign-owned firms finds that productivity in the acquired local plants increases following foreign acquisitions, thereby providing indirect evidence that headquarters of multinationals transfer knowledge to their newly acquired affiliates.\(^3\) As plants that are acquired by foreign owners operate in the local economy already before the change in ownership, the potential for spillovers to other domestic plants may be greater from them than from greenfield entrants. These firms will have established linkages with the host country that the greenfield entrants have yet to build. Moreover, labour turnover associated with the change in ownership may act as a channel for knowledge transfer to domestic plants. If knowledge diffusion takes time to materialise, this type of spillover may also be more likely from foreign-owned firms that have been in the market for some time. Sembenelli and Siotis (2008), in their analysis of the impact of FDI on markups of manufacturing firms in Spain, find weak evidence that foreign presence dampens margins in the short run, but also a longer-term compensating positive effect in R&D intensive industries which they interpret as evidence of knowledge diffusion.

Regarding the competition channel there could be different forces at play: First, if entry by new and efficient firms forces incumbents to reduce x-inefficiencies or to adopt new technologies faster than they otherwise would, average productivity in the host country industry may increase.\(^4\) To the extent that technology and knowledge transfer is highest in the initial years of the investment, we do not expect well-established foreign-owned firms to exert strong positive or negative pro-competitive effects.

Second, greenfield and acquisition entry will affect competitive pressure differently due to the way they affect market structure. While the theoretical literature on the choice between greenfield and acquisition entry cited above emphasises market structure or rather market power considerations as an important motive, these models are largely silent on the implications of the mode of foreign entry for the host country firms. As noted in UNCTAD (2000, p.145), an

\(^3\)Examples are McGuckin and Nguyen (1995) for the US, Harris and Robinson (2002) and Criscuolo and Martin (2009) for the UK.

\(^4\)Aghion et al. (2009) demonstrate that foreign greenfield entry in the UK increases the incentives of firms to innovate in order to survive the increased competition.
important difference between the two entry modes, is that greenfield entry increases production capacity while entry via acquisition leaves production capacity unchanged at least in the short run. The increase in production capacity following greenfield entry can lead to increased competition, and, thereby, to reduced domestic market shares as argued in Aitken and Harrison (1999). A reduction in output prices is another conceivable outcome. In contrast, unless a foreign acquisition ends collusive behaviour in the industry, competition in the industry will not be affected in short run. If the acquired plant undergoes substantial restructuring as a result of the acquisition, pro-competitive effects will take longer to materialise.

In addition to increasing competition in output markets, new foreign entrants may also increase competition in input markets. While capital goods and material inputs can be sourced from abroad without too much difficulty, multinationals typically hire a substantial share of their labour force locally. Given the higher wages they pay, they are likely to attract key employees from domestic competitors. This may have a detrimental effect on the productivity of domestic plants if they must use resources to replace these employees. This effect should be stronger from greenfield entrants as the increase in employment in these plants in Norway is much higher than that in plants acquired by foreign owners (Balsvik and Haller, forthc.).

3 Empirical specification

In order to examine the impact of different modes of foreign entry on the productivity of domestic firms, we start with an augmented production function of the following form

\[
\ln Y_{it} = \beta_K \ln K_{it} + \beta_M \ln M_{it} + \beta_H \ln H_{it}
\]

\[
+ \sum_{k=0}^{T} \beta_1^k FP_{I,t-k} + \sum_{k=0}^{T} \beta_2^k FP_{R,t-k} + \gamma Z_{it} + \upsilon_i + \epsilon_{it}.
\]

This type of equation is commonly used to investigate whether FDI generates intra-industry spillovers (e.g. Castellani and Zanfei 2006, Haskel et al. 2007). In equation (1) \( \ln Y \), \( \ln K \), \( \ln M \), and \( \ln H \) are the natural logs of output, capital, hours and materials in plant \( i \), year \( t \). For the construction of all variables, see the variable definitions in the Appendix. \( Z \) includes a set of competition variables and \( \upsilon_i \) is an unobserved plant-specific effect.
Given that we are controlling for input use, \( FP_{I,t-k} \) measures the impact of foreign presence on the productivity of domestic plants. In the previous spillover literature this is the variable of main interest. In the case of intra-industry spillovers, \( FP_{I,t-k} \) captures overall foreign presence at the industry level. A positive coefficient is consistent with spillovers from foreign firms to domestic firms in the same industry. We calculate \( FP_{I,t-k} \) at the 5-digit ISIC level and measure it as the share of employment in foreign-owned plants in total industry employment. We have 140 5-digit sectors in our estimations.\(^5\) Similarly \( FP_{R,t-k} \) captures spillovers from overall foreign presence at the region level. We calculate \( FP_{R,t-k} \) at the labour market region level as identified by Statistics Norway on the basis of commuting patterns (Bhuller, 2009); there are 46 labour market regions in Norway. As the effects from foreign presence may take time to materialise, we include 2 lags of foreign presence in our estimations.\(^6\)

We use a set of variables similar to those first proposed by Nickell (1996) to control for competition. These include industry concentration (\( CR5_{It} \)), market share (\( MS_{It} \)), and profit margins (\( PM_{It} \)). As our concentration measure we use the sum of market shares of the five largest plants defined at the 5-digit industry level. Technological differences across industries imply very different requirements in terms of size and scale for firms to be able to operate in their respective environments, see Sutton (1996). High market shares, therefore, need not indicate a lack of competition. However, as argued by Nickell (1996), changes in market structure over time are still going to be reasonably good measures of changes in competition. The profit margin measure is thought to capture possible rents that may be available to shareholders and workers in the form of higher pay and lower effort. The expected signs on the concentration measure, market share and profit margin are negative: higher profit margins allow scope for lower effort and thus lower productivity, and higher market shares or concentration ratios are associated with lower effort and productivity levels. As higher productivity would raise both profit margins and market shares, these variables are potentially endogenous. We follow Haskel et al. (2007) and address this problem by lagging both measures. We use two-period lags and note that endogeneity would give rise to an upward bias in the estimated coefficients. We

\(^5\)The mean number of plants in a 5-digit sector is 40 with a standard deviation of 60; the median number of plants is 17.

\(^6\)We also tested for longer lag lengths, but more than two lags were never significant.
also tried different control variables for import intensity and a control for the rate of turnover of plants in an industry. However, these variables were never significant. Information for import competition is only available at the 2- to 3-digit industry level, thus, our industry-year interaction dummies described below will capture unobserved variation at this level.

It is conceivable that foreign entry is directed mainly at fast growing industries: to control for this possibility at a more disaggregate level we include changes in 5-digit industry output and industry employment excluding each plant’s own change in output $\Delta(Y_{it} - Y_{it})$ and employment $\Delta(L_{it} - L_{it})$. Taken together these two control variables will capture changes in average labour productivity in the industry, hence we expect the sign on $\Delta(Y_{it} - Y_{it})$ to be positive and the sign on $\Delta(L_{it} - L_{it})$ to be negative.

The productivity of a plant is likely to be affected by unobserved variables. We eliminate unobserved plant-specific effects by time-differencing equation (1). Taking first-differences also eliminates the effects from any unobserved time invariant industry or regional variables. In our first-differenced equation we add year dummies to take account of common shocks that may be correlated with foreign presence across all industries. By including NUTS2 region and 3-digit industry dummies, we account for both region- and industry-specific linear time trends in the levels of the dependent variable. In addition, we add a set of 2-digit industry-year interaction terms to account for possible correlations between foreign presence and industry-specific shocks.$^7$ Including these dummies further implies that our results rely on differences in plant productivity and foreign presence or foreign entry from their year, region and industry means rather than on differences in plant productivity across sectors or years. On the basis of the above considerations, we estimate the following equation on the sample of plants that are Norwegian-owned throughout their presence in our panel.

$$\Delta \ln Y_{it} = \alpha_K \Delta \ln K_{it} + \alpha_M \Delta \ln M_{it} + \alpha_H \Delta \ln H_{it} + \sum_{k=0}^{2} \beta_{1k} \Delta FP_{I,t-k} + \sum_{k=0}^{2} \beta_{2k} \Delta FP_{R,t-k}$$

$$+ \gamma_1 \Delta MS_{i,t-2} + \gamma_2 \Delta PM_{i,t-2} + \gamma_3 \Delta CR5_{I,t} + \gamma_4 \Delta(Y_{It} - Y_{it}) + \gamma_5 \Delta(L_{It} - L_{it})$$

$$+ \upsilon_t + \upsilon_R + \upsilon_I + \upsilon_{It} + \xi_{it}. \quad (2)$$

$^7$There are 5 NUTS2 regions in Norway, and 28 3-digit industries and 9 2-digit industries in our data.
In line with the previous spillover literature, we first estimate equation (2) taking \( \Delta FP_{It} \) and \( \Delta FP_{Rt} \) to be the first-difference of overall foreign presence at the industry and at the labour market region level, respectively. In what follows we use \( \Delta FP_{It} \) for illustration, but the decomposition applies similarly to foreign presence at the labour market region level (\( \Delta FP_{Rt} \)). \( \Delta FP_{It} \) represents the change, from \( t-1 \) to \( t \), in overall foreign presence in the industry, and is given as

\[
\Delta FP_{It} = \sum_{i \in FO_{It}} \frac{(Empl)_it}{(Total empl)_{It}} - \sum_{i \in FO_{I,t-1}} \frac{(Empl)_{i,t-1}}{(Total empl)_{I,t-1}}. \tag{3}
\]

In equation (3) \( FO_{It} \) is the set of foreign-owned plants in industry \( I \) at time \( t \). A change in foreign presence can come about through greenfield entry of foreign plants, foreign acquisitions, employment expansion or contraction in existing foreign-owned firms, and also by foreign-owned firms divesting or closing down.\(^8\) If recent foreign entrants have a different effect on the productivity of domestic firms than long established foreign-owned firms, using a measure of overall foreign presence in the regression may generate ambiguous results. The same argument applies if different modes of entry have different effects on domestic productivity.

In our second specification we split \( \Delta FP_{It} \) into three parts in order to isolate the effect of some important sources of change in overall foreign presence. As our decomposition focuses on greenfield and acquisition entry, we group the remaining possible changes from pre-existing foreign presence into one term. The set of foreign-owned firms \( FO_{It} \) at time \( t \) can then be split into the sets of greenfield entrants (\( GE_{It} \)), acquisition entrants (\( AE_{It} \)), and the set of remaining foreign-owned plants that have been present in the sector for at least one year (\( FO_{1It} \)), hence \( FO_{It} = GE_{It} \cup AE_{It} \cup FO_{1It} \). Using these definitions of the different groups of foreign plants in year \( t \), we can rewrite equation (3) in the following way

\[
\Delta FP_{It} = \sum_{i \in GE_{It}} \frac{(Empl)_it}{(Total empl)_{It}} + \sum_{i \in AE_{It}} \frac{(Empl)_it}{(Total empl)_{It}} + \left( \sum_{i \in FO_{1It}} \frac{(Empl)_it}{(Total empl)_{It}} - \sum_{i \in FO_{I,t-1}} \frac{(Empl)_{i,t-1}}{(Total empl)_{I,t-1}} \right)
\equiv G_{It} + A_{It} + \Delta F_{It}. \tag{4}
\]

\(^8\) Aghion et al. (2004) use the first difference of foreign presence to represent foreign entry in their study of the impact of entry on productivity growth in the UK, although a change in foreign presence need not only be caused by new entry of foreign firms.
The first term $G_{It}$ in equation (4) represents the change in foreign presence between $t - 1$ and $t$ accounted for by greenfield entry. We measure this as the sum of employment in those plants in industry $I$ that are greenfield entrants in year $t$ expressed as a share of total employment in the industry that year. Similarly, $A_{It}$ represents the change in foreign presence due to foreign acquisitions in industry $I$ between $t - 1$ and $t$. $G_{It}$ and $A_{It}$ represent the flow of new FDI into the sector differentiated by the mode of entry. The last term $\Delta F_{It}$ equals the two terms in brackets, and represents the remaining change in foreign presence between $t - 1$ and $t$. $\Delta F_{It}$ captures employment expansion or contraction of existing foreign-owned firms relative to total industry employment, and also withdrawal of foreign firms through divestures or plant closures.

4 Data

Our main data source is the annual census of all Norwegian manufacturing plants collected by Statistics Norway. The Norwegian Manufacturing Statistics are collected at the plant level, where the plant is defined as a functional unit at a single physical location, engaged mainly in activities within a specific activity group. The plant-level variables include detailed information on production, input use, investment, location, and industry classification (ISIC Rev. 2).

We drop plants with less than 8 employees throughout their lives and observations of plants not in ordinary production (service units or plants under construction). The resulting sample contains 150,000 observations from 10,400 plants for the period 1978-2001, with an average plant size of 43 employees. The sample covers more than 90% of total manufacturing output and employment.

Information about foreign ownership is recorded directly in the Manufacturing Statistics before 1990. Plants are classified into three ownership classes; plants that are part of firms where less than 20%, 20-50%, or more than 50% of equity is directly foreign owned. From 1991 onwards we have information on foreign ownership from the SIFON-register, which is an annual record of foreign ownership of equity in Norwegian firms. The SIFON-register also

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9In addition, we drop plants that in the Norwegian Manufacturing Statistics are classified as ‘small’ (defined as having less than 5 or 10 employees) throughout their life. The information for these plants comes mainly from administrative registers and is therefore less extensive than for large plants. In particular, there is no investment information, which means that we are unable to construct capital measures for this group of plants.
records indirect foreign ownership.\textsuperscript{10} As the indirectly foreign-owned plants are more similar to the directly foreign-owned plants than to the domestic plants in terms of mean size and productivity, we prefer to include indirect foreign ownership into the group of foreign-owned plants. Thus, we classify plants as foreign owned when either direct or indirect foreign ownership of equity is above the 50\% threshold.

Figure 1: Foreign presence in Norwegian manufacturing
likely to underestimate the extent of foreign ownership before the early 1990s. We are aware
that the extended definition of foreign ownership causes a break in our definitions of foreign
entry and foreign presence, thus, in Section 5, we check that our results are not sensitive to the
inclusion of indirect foreign ownership in the 1990s.

In the Norwegian Manufacturing Statistics each plant is assigned an identification number
which it keeps throughout its life. A plant will even keep its previous identification number
when it re-enters the panel after a time of inactivity as long as production restarts in the same
geographic location. Mergers or buy-outs at the firm level do not affect the plant identification
code. Since our data are from a census, we avoid the problem of possible false entries and exits
due to plants not being sampled. We define a plant as an entrant in year $t$ if it appears for the
first time in year $t$, or reappears in that year after a temporary closure.$^{12}$ Similarly we define
an exit in year $t$ if the plant is present in year $t$ and temporarily closed in $t + 1$, or absent all
subsequent years.

Table 1: Foreign and domestic plants: numbers and mean size

<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>number of plants</td>
<td>5,535</td>
<td>5,109</td>
<td>4,372</td>
<td>3,937</td>
<td>8,119</td>
</tr>
<tr>
<td>Domestic plants</td>
<td>avg</td>
<td>avg</td>
<td>avg</td>
<td>avg</td>
<td>avg</td>
</tr>
<tr>
<td>Foreign-owned plants</td>
<td>195</td>
<td>218</td>
<td>336</td>
<td>442</td>
<td>313</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Greenfield entry</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>- Acquisition entry</td>
<td>16</td>
<td>25</td>
<td>51</td>
<td>47</td>
<td>37</td>
</tr>
<tr>
<td>mean plant size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic plants</td>
<td>30</td>
<td>28</td>
<td>27</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Foreign-owned plants</td>
<td>99</td>
<td>94</td>
<td>81</td>
<td>101</td>
<td>96</td>
</tr>
<tr>
<td>Greenfield entry</td>
<td>17</td>
<td>25</td>
<td>31</td>
<td>71</td>
<td>49</td>
</tr>
<tr>
<td>Acquisition entry</td>
<td>66</td>
<td>71</td>
<td>92</td>
<td>114</td>
<td>89</td>
</tr>
</tbody>
</table>

The upper part of Table 1 depicts the numbers of foreign and domestic plants in our sample.
The total number of plants and foreign entrants from 1978-2001 can be found in the last column
of Table 1. There are a total of 181 greenfield entries and 875 foreign acquisitions during this

$^{12}$Although the logic of the census would imply that a plant is not in operation if it is not observed, we assume
that when a plant is missing for one or two consecutive years, this is due to lack of registration rather than a
temporary closure. When a plant disappears for three or more consecutive years before it reappears, we regard
it as temporarily closed and thus count an extra exit and entry for that plant. We also define as temporarily
closed those plants that are missing for two consecutive years, but reappear with a new owner (a new firm
identification number). Less than 2.5% of the plants in the sample have what we define as temporary closures.
period, and we observe 1,099 distinct foreign-owned plants. The remaining columns show the annual average number of plants over the whole period and different subperiods. During the period of analysis the number of domestic plants in our sample decreased from an average of 5,535 per year before 1985 to an average of 3,937 plants per year during the 1995-1999 period. This reflects the overall decline in the manufacturing sector during this period. The lower part of Table 1 shows the mean size of the different groups of plants. As expected, the foreign-owned plants are larger than the domestic plants. Even the foreign greenfield entrants are on average larger than domestic plants.\(^{13}\)

For the econometric analysis we clean the data with respect to missing observations and outliers. We drop plants with missing information on inputs or output for 80% or more of their life. We also drop all observations of plants with one or more observations on profit margins in the top or bottom half percentile. This cleaning procedure drops 10% of the observations in the initial sample. In our regressions we look at the effect of foreign presence and foreign entry on the productivity of plants that have less than 20% foreign ownership throughout their presence in our sample (hereafter called domestic plants). Summary statistics of the regression variables are presented in Table 6 in the Appendix.

5 Results

Based on the discussion in Section 3, we estimate equation (2) on domestic plants using first the overall change in foreign presence, \(\Delta FP_{It}\) and \(\Delta FP_{Rt}\), as defined in equation (3). Results are presented in the first column of Table 2. All inputs are significant. Of the competition variables, market share, concentration, and profit margin have the expected negative signs. This indicates that reduced competitive pressure has a negative effect on productivity. Our measures of industry output and employment growth also have the expected opposing signs. The change in overall foreign presence is entered with its current value and two lags. The coefficients on foreign presence at the industry level are positive, and the second lag is significant. Its economic effect is small; the estimated coefficient on the second lag indicates that a 10-percentage-point increase in foreign presence two years ago raises TFP of the domestic plants by 0.42%. The

\(^{13}\)The average domestic entrant over the whole period has 20 employees.
coefficients on foreign presence at the region level have different signs, the contemporaneous coefficient reaches significance at the 10% level. This implies that a 10 percentage point increase in foreign presence in the current year reduces the productivity of domestic firms in the same region by 0.39%. In the row with $\sum \Delta FP$ we sum the three coefficients on the change in foreign presence: the cumulative effect at the industry level is positive and significant. The cumulative effect at region level is negative but not significant. Note that the economic effect of foreign presence at the industry level is similar to that estimated by Haskel et al. (2007); they find that a 10 percentage point increase in foreign presence in a U.K. industry raises the TFP of that industry’s domestic plants by about 0.5%. They do not find an effect at the region level.

As argued earlier, this measure of overall foreign presence combines the effects from recent foreign entrants and from foreign firms that have been present for more than one year. In addition, the overall foreign presence term cannot distinguish between different modes of foreign entry. The small effects of overall foreign presence could be the results of opposing effects of different sources of changes in foreign presence. To examine this, we split the overall change in foreign presence according to equation (4). The results are presented in columns 2-4 of Table 2. In order to demonstrate that the coefficients on foreign entry at the industry level are independent of the coefficients on foreign entry at the region level, column 2 contains only industry-level entry rates and column 3 contains only region-level industry rates. In column 4 both types of entry rates are included jointly. In all three columns with foreign entry the coefficients on inputs and controls are almost identical to those in the equations with overall foreign presence.\textsuperscript{14} The coefficients on greenfield entry at industry level are negative, with contemporaneous greenfield entry and its first lag being significant at the 10 and 1% level, respectively. Their cumulative effect is also negative and significant. For greenfield entry we also find the first lag at the labour market region level to be negative and significant; the joint effect at the region level is also negative and significant. Regarding acquisitions, at the industry level all three coefficients are positive, but only the first lag is significant; their cumulative effect

\textsuperscript{14}As is common in this type of regression most of the variation is explained by the inputs. The year and industry dummies add about 2 percentage points, the competition variables and the terms for foreign presence/foreign entry each add less than 1 percentage point of explanatory power. If the competition variables or industry growth rates are excluded from any of these regressions, the results do not change beyond minor ups or downs past the first digit.

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Table 2: Foreign Presence, Mode of Foreign Entry and Domestic Productivity

<table>
<thead>
<tr>
<th></th>
<th>overall foreign presence</th>
<th>greenfield, acquisition entry and change in existing foreign presence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>industry&amp;region</td>
<td>industry</td>
</tr>
<tr>
<td>$\Delta \ln K_{it}$</td>
<td>.072 (.003)**</td>
<td>.072 (.003)**</td>
</tr>
<tr>
<td>$\Delta \ln M_{it}$</td>
<td>.524 (.006)**</td>
<td>.524 (.006)**</td>
</tr>
<tr>
<td>$\Delta \ln H_{it}$</td>
<td>.303 (.007)**</td>
<td>.303 (.007)**</td>
</tr>
<tr>
<td>$\Delta CRI_{it}$</td>
<td>-.102 (.017)**</td>
<td>-.100 (.018)**</td>
</tr>
<tr>
<td>$\Delta PM_{I,t-1}$</td>
<td>-.056 (.007)**</td>
<td>-.056 (.007)**</td>
</tr>
<tr>
<td>$\Delta MS_{I,t-1}$</td>
<td>-.127 (.058)*</td>
<td>-.128 (.058)*</td>
</tr>
<tr>
<td>$\Delta \ln (Y_{it} - Y_{i})$</td>
<td>.086 (.009)**</td>
<td>.088 (.009)**</td>
</tr>
<tr>
<td>$\Delta \ln (L_{it} - L_{i})$</td>
<td>-.088 (.010)**</td>
<td>-.088 (.010)**</td>
</tr>
<tr>
<td>$\Delta FP_{I}$</td>
<td>.016 (.013)</td>
<td></td>
</tr>
<tr>
<td>$\Delta FP_{I,t-1}$</td>
<td>.010 (.014)</td>
<td></td>
</tr>
<tr>
<td>$\Delta FP_{I,t-2}$</td>
<td>.042 (.015)**</td>
<td></td>
</tr>
<tr>
<td>$\Delta FP_{R,t}$</td>
<td>-.039 (.021)**</td>
<td></td>
</tr>
<tr>
<td>$\Delta FP_{R,t-1}$</td>
<td>.001 (.023)</td>
<td></td>
</tr>
<tr>
<td>$\Delta FP_{R,t-2}$</td>
<td>-.012 (.023)</td>
<td></td>
</tr>
<tr>
<td>$G_{It}$</td>
<td>-.135 (.075)**</td>
<td>-.135 (.075)**</td>
</tr>
<tr>
<td>$G_{I,t-1}$</td>
<td>-.191 (.072)**</td>
<td>-.192 (.072)**</td>
</tr>
<tr>
<td>$G_{I,t-2}$</td>
<td>.001 (.083)</td>
<td>.004 (.082)</td>
</tr>
<tr>
<td>$A_{It}$</td>
<td>.004 (.018)</td>
<td>.004 (.018)</td>
</tr>
<tr>
<td>$A_{I,t-1}$</td>
<td>.083 (.022)**</td>
<td>.082 (.022)**</td>
</tr>
<tr>
<td>$A_{I,t-2}$</td>
<td>.028 (.023)</td>
<td>.029 (.023)</td>
</tr>
<tr>
<td>$\Delta F_{It}$</td>
<td>.026 (.021)</td>
<td>.026 (.021)</td>
</tr>
<tr>
<td>$\Delta F_{I,t-1}$</td>
<td>-.057 (.022)**</td>
<td>-.057 (.022)**</td>
</tr>
<tr>
<td>$\Delta F_{I,t-2}$</td>
<td>.038 (.022)**(*</td>
<td>.038 (.022)**(*)</td>
</tr>
<tr>
<td>$G_{Rt}$</td>
<td>-.036 (.151)</td>
<td>-.027 (.151)</td>
</tr>
<tr>
<td>$G_{R,t-1}$</td>
<td>-.392 (.178)*</td>
<td>-.381 (.178)*</td>
</tr>
<tr>
<td>$G_{R,t-2}$</td>
<td>.017 (.170)</td>
<td>.019 (.170)</td>
</tr>
<tr>
<td>$A_{Rt}$</td>
<td>-.032 (.025)</td>
<td>-.032 (.025)</td>
</tr>
<tr>
<td>$A_{R,t-1}$</td>
<td>.006 (.028)</td>
<td>.002 (.028)</td>
</tr>
<tr>
<td>$A_{R,t-2}$</td>
<td>-.042 (.029)</td>
<td>-.044 (.029)</td>
</tr>
<tr>
<td>$\Delta F_{Rt}$</td>
<td>-.047 (.041)</td>
<td>-.046 (.041)</td>
</tr>
<tr>
<td>$\Delta F_{R,t-1}$</td>
<td>.012 (.041)</td>
<td>.014 (.041)</td>
</tr>
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<td>$\Delta F_{R,t-2}$</td>
<td>.052 (.042)</td>
<td>.052 (.042)</td>
</tr>
<tr>
<td>$R^2$ adj.</td>
<td>.79</td>
<td>.79</td>
</tr>
<tr>
<td>N/Plants</td>
<td>85900/7363</td>
<td>85900/7363</td>
</tr>
</tbody>
</table>

Note: Dependent variable is $\Delta \ln Y_{it}$. Year dummies, region dummies, 3-digit industry dummies, and 2-digit industry - year interaction terms included in all regressions. All variables in the table with an $I$ subscript are defined at the 5-digit industry level. ***, **, (*) indicate significance at 1%, 5%, and 10% respectively. Robust standard errors adjusted for clustering at the plant level in round parentheses.
is positive and significant. At the region level none of the individual coefficients are significant, but their joint effect is negative and significant. Our estimates imply that a ten percentage point increase in the greenfield entry rate in a particular industry one year ago is associated with a decrease in the productivity of the domestic plants in that industry of 1.9%. A similar increase in last year’s acquisition rate is associated with an increase in productivity of 0.8% for the domestic plants in that industry.\textsuperscript{15} In addition, a 10 percentage point increase in the greenfield entry rate in a particular region last year is associated with a reduction in the productivity of domestic plants in that labour market region by 3.8%.

The effect of the change in preexisting foreign presence, $\Delta F_I$, is somewhat ambiguous. The first lag is negative and significant at the 1\% level, whereas the two other coefficients are positive, the second lag reaching significance at the 10\% level. The cumulative effect of the $\Delta F_I$-terms is close to zero and not significant. At the region level none of the coefficients on the change in preexisting foreign presence are significant. The fact that it is always the first lag that has a significant sign for each component of foreign presence might suggest a degree of multicollinearity. However, when we enter each of the 18 foreign entry terms individually, when we enter only contemporaneous, only first or only second lags together or when we enter only the terms for one type of foreign investment at a time, the results are very similar. These results are displayed in Tables 7 and 8 in the Appendix.

There are a number of estimation issues that we need to address in order to assess the robustness of our main finding that greenfield foreign entry and foreign entry through acquisitions give rise to opposite effects on the productivity of domestic firms in the same sector. In what follows we present results where we change the definition of foreign ownership and the measures of productivity. We also address the possibility of selection bias and endogeneity.

\textbf{Definition of foreign ownership}

As noted in Section 4, from 1990 onwards our definition of foreign ownership includes both directly and indirectly foreign-owned plants. This might suggest that some of the foreign entry in our estimations is due to reclassifications rather than actual foreign entry. To address this,\textsuperscript{15}The difference between these two effects is statistically significant at the 1\% level.
we estimate equation (2) with the foreign entry and acquisition variables based on direct foreign ownership which we observe throughout the period. We obtain the results shown in the first column of Table 3. Here it is the second lag of greenfield entry at the industry level that is negative and significant, but overall the results are similar to those in our basic regression in column 4 of Table 2. Thus our results do not seem sensitive to the extended definition of foreign ownership in the 1990s.

In our base results plants are considered to be foreign if 50% or more of equity is directly or indirectly controlled by foreign owners. In column 2 of Table 3 we reduce this threshold to 20%. With this specification we do not measure a negative effect from greenfield entry at the industry level, while the negative effect from greenfield entry in the same region persists. The coefficients on acquisition entry are jointly significant and positive and there is a positive effect from the change in preexisting foreign presence at the industry level. Most foreign entrants in Norwegian manufacturing hold a majority stake in their subsidiaries, less than one third of foreign-owned plants have below 50% foreign ownership. This makes the results for the minority foreign-owned entrants (20-50% ownership) much more sensitive to the exclusion of certain industries, while the results for foreign ownership defined above 50% remain qualitatively the same irrespective of which 2-digit industry we exclude. Previous work examining whether the extent of spillovers from foreign presence depends on the degree of ownership is inconclusive. Blomström and Sjöholm (1999) conclude that the extent of spillovers is not different from minority and majority foreign-owned firms in Indonesia, while Dimelis and Louri (2002) find that spillovers to domestic firms in the same sector are most prominent from minority foreign-owned firms in Greece.

From 1991 onwards we have information on the exact share of foreign ownership, for this period we define foreign ownership at the 100% level as well. For the foreign entries after 1990, 86 and 72% of, respectively, the greenfield and acquisition entrants with majority foreign ownership are fully foreign owned. If we increase the foreign ownership threshold to 100% as in column 3 of Table 3, our results are similar to before. Therefore the opposite effects on domestic productivity that we obtain are not due to a differences in the extent to which greenfield and acquisition entrants choose to take a 100% share of foreign ownership. The differences in the results for greenfield entry at the industry level depending on whether we
Table 3: Definition of foreign ownership, selection, endogeneity

<table>
<thead>
<tr>
<th></th>
<th>direct foreign ownership</th>
<th>20% foreign ownership threshold</th>
<th>100% foreign ownership from 1991</th>
<th>Heckman selection model</th>
<th>effect on surviving plants</th>
<th>excl. ind.-year cells with only greenfield or plants only acquisition entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>$G_{it}$</td>
<td>-.093 (.178)</td>
<td>-.043 (.057)</td>
<td>-.218 (.082)**</td>
<td>-.082 (.080)</td>
<td>-.120 (.083)</td>
<td>-.528 (.220)**</td>
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<tr>
<td>$G_{I,t-1}$</td>
<td>-.214 (.180)</td>
<td>.002 (.045)</td>
<td>-.211 (.075)**</td>
<td>-.210 (.072)**</td>
<td>-.188 (.074)*</td>
<td>-.187 (.080)*</td>
</tr>
<tr>
<td>$A_{I,t}$</td>
<td>-.380 (.166)*</td>
<td>.106 (.067)</td>
<td>.050 (.085)</td>
<td>.036 (.088)</td>
<td>.064 (.088)</td>
<td>.109 (.090)</td>
</tr>
<tr>
<td>$A_{I,t-1}$</td>
<td>.017 (.023)</td>
<td>-.003 (.015)</td>
<td>.054 (.027)</td>
<td>.001 (.018)</td>
<td>.004 (.022)</td>
<td>.082 (.058)</td>
</tr>
<tr>
<td>$A_{I,t-2}$</td>
<td>.045 (.025)*</td>
<td>.021 (.016)</td>
<td>.092 (.034)**</td>
<td>.077 (.023)**</td>
<td>.035 (.025)</td>
<td>.042 (.027)</td>
</tr>
<tr>
<td>$ΔF_{It}$</td>
<td>.006 (.028)</td>
<td>.023 (.018)</td>
<td>.025 (.030)</td>
<td>.009 (.025)</td>
<td>.026 (.022)</td>
<td>.026 (.027)</td>
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<tr>
<td>$ΔF_{It,t-1}$</td>
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<td>-.014 (.015)</td>
<td>-.116 (.034)**</td>
<td>-.046 (.023)*</td>
<td>-.005 (.025)</td>
<td>-.073 (.028)**</td>
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<td>$ΔF_{It,t-2}$</td>
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<td>.032 (.016)*</td>
<td>.053 (.036)</td>
<td>.030 (.022)</td>
<td>-.019 (.028)</td>
<td>.034 (.026)</td>
</tr>
<tr>
<td>$G_{R,t}$</td>
<td>.042 (.181)</td>
<td>-.165 (.100)**</td>
<td>-.155 (.171)</td>
<td>-.026 (.162)</td>
<td>-.070 (.196)</td>
<td>-.046 (.175)</td>
</tr>
<tr>
<td>$G_{R,t-1}$</td>
<td>-.384 (.214)*</td>
<td>-.140 (.083)**</td>
<td>-.421 (.193)*</td>
<td>-.314 (.178)**</td>
<td>-.254 (.202)</td>
<td>-.427 (.199)**</td>
</tr>
<tr>
<td>$G_{R,t-2}$</td>
<td>-.007 (.190)</td>
<td>.065 (.092)</td>
<td>-.130 (.190)</td>
<td>-.137 (.188)</td>
<td>.168 (.185)</td>
<td>.175 (.182)</td>
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<tr>
<td>$A_{R,t}$</td>
<td>-.017 (.048)</td>
<td>.002 (.014)</td>
<td>-.108 (.045)*</td>
<td>-.041 (.027)</td>
<td>-.023 (.031)</td>
<td>-.047 (.029)</td>
</tr>
<tr>
<td>$A_{R,t-1}$</td>
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<td>.013 (.016)</td>
<td>-.014 (.054)</td>
<td>.013 (.029)</td>
<td>.026 (.034)</td>
<td>.009 (.032)</td>
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<tr>
<td>$A_{R,t-2}$</td>
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<td>-.018 (.016)</td>
<td>-.077 (.041)**</td>
<td>-.040 (.031)</td>
<td>-.084 (.038)*</td>
<td>-.067 (.034)**</td>
</tr>
<tr>
<td>$ΔF_{R,t}$</td>
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<td>-.022 (.018)</td>
<td>-.046 (.034)</td>
<td>-.039 (.044)</td>
<td>-.019 (.049)</td>
<td>-.023 (.053)</td>
</tr>
<tr>
<td>$ΔF_{R,t,t-1}$</td>
<td>-.029 (.048)</td>
<td>-.015 (.018)</td>
<td>-.033 (.035)</td>
<td>-.001 (.042)</td>
<td>.000 (.053)</td>
<td>.013 (.050)</td>
</tr>
<tr>
<td>$ΔF_{R,t,t-2}$</td>
<td>.034 (.044)</td>
<td>.011 (.017)</td>
<td>-.009 (.039)</td>
<td>.021 (.042)</td>
<td>.001 (.056)</td>
<td>.049 (.047)</td>
</tr>
<tr>
<td>adj R²/χ²</td>
<td>.79</td>
<td>.79</td>
<td>15.91</td>
<td>.74</td>
<td>.79</td>
<td>.78</td>
</tr>
<tr>
<td>ρ</td>
<td></td>
<td></td>
<td>-.064 (.016)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>85900</td>
<td>85900</td>
<td>31330</td>
<td>85900</td>
<td>38892</td>
<td>63533</td>
</tr>
<tr>
<td>Plants</td>
<td>7363</td>
<td>7363</td>
<td>4572</td>
<td>7363</td>
<td>1852</td>
<td>7165</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>∑ $ΔF_{I}$ [p-value]</td>
<td>-.007 [.834]</td>
<td>.043 [.966]</td>
<td>-.031 [.513]</td>
<td>-.012 [.703]</td>
<td>-.054 [.162]</td>
<td>-.026 [.527]</td>
</tr>
</tbody>
</table>

Note: Dependent variable is Δ ln $Y_{it}$. Regressors Δ ln $K_{it}$, Δ ln $M_{it}$, Δ ln $H_{it}$, Δ MS, $t-2$, Δ PM, $t-2$, Δ CR, $t-2$, Δ ln ($Y_{it} - Y_{i,t-1}$), Δ ln ($L_{it} - L_{i,t-1}$) as well as year dummies, region dummies, 3-digit industry dummies, and 2-digit - year interaction terms are included but not displayed for brevity. **, *, (*) indicate significance at 1%, 5%, and 10% respectively. Robust standard errors adjusted for clustering at the plant level in round parentheses. Selection in the first stage of the regression in column 3 is determined by capital and investment (levels to 4th powers). $χ²$ is the test statistic for the joint significance of the variables in the selection equation. $ρ$ is the selection term. $χ²$ is the test statistic for the joint significance of the variables in the selection equation. $ρ$ is the selection term.
define foreign ownership at the 20%, 50% or 100% threshold point in the same direction as the results of Smarzynska Javorcik and Spatareanu (2008) for Romania. They conclude that the negative competition effect is smaller from jointly owned enterprises than from fully foreign-owned enterprises, they do not distinguish between greenfield and acquisition entry, however.

**Selection**

As the variables of main interest are foreign entry, we should take into account that the estimated relationship between these variables and productivity could be biased by selection on survival. Suppose for example, that both modes of foreign entry truly have a positive effect on the productivity of domestic firms, or that foreign entry occurs primarily in sectors with good market growth prospects. In such sectors, even low productivity firms may survive, creating a negative correlation between foreign entry and productivity among surviving firms. If this is the case we would be underestimating the positive effects of foreign acquisitions, and overstating the negative effect of greenfield entry. Conversely, if foreign entry increases competitive pressure such that the least productive domestic firms in the sector exit as a result of foreign entry, there will be a positive correlation between foreign entry and productivity among surviving firms. Thus, selection could work in both directions and the overall bias is unknown.

To address this potential problem we re-estimate the model from the second column using the Heckman selection procedure where survival is conditioned on a probit of so-called hazard variables that determine exit. Olley and Pakes (1996) suggest a structural model where survival is conditioned on investment and capital. This is to capture the idea that investment which is observable but not correlated with current output can pick up unobservable shocks to productivity. The result from using investment and capital from levels to their fourth powers as selection variables in a Heckman selection model to capture the Olley and Pakes idea is presented in column 4 of Table 3. The results are very similar to those in our original specification in column 4 of Table 2 without the selection correction. The variables in the selection probit are jointly significant, as indicated by the $\chi^2$-value. The selection term $\rho$ is also significant.

Another way to gauge whether our results are biased by selection is to note that if most of the adjustment to foreign entry is at the exit margin, we should expect a much smaller effect
of foreign entry on the surviving firms. When we restrict the sample to only those domestic firms that are present for the entire period from 1978 to 2001 we obtain the results presented in column 5 Table 3. The number of plants reduces to one quarter of the original sample and the sample size to less than half. The results for greenfield entry at the industry level are remarkably similar to the original specification in Table 2, indicating that the surviving plants carry the largest share of the adjustment to greenfield entry. In contrast, none of the coefficients on foreign entry by acquisition in the same sector is significant and their joint effect is smaller in this sample of survivors than in the main sample. This suggests that some of the benefit from foreign acquisitions goes to new domestic entrants.

Endogeneity of the mode of entry

The mode of entry into a new market is a strategic variable for multinationals, thus it could be the case that the foreign entrants’ choice of which industry or region to enter or which firm to acquire depends on the current or future expected performance of plants in that industry. Any systematic correlation between mode of entry and the level of industry or region productivity is removed by taking first differences, moreover we control for changes in industry output and employment growth. Thus our results cannot be explained by greenfield entrants systematically entering in low-productivity industries or regions and acquisitions predominantly taking place in high-productivity industries or regions. The use of year dummies and industry-year interaction terms will take out any systematic correlation between the mode of entry and both aggregate and industry-specific business cycles, while the industry and region dummies should pick up systematic correlations between the mode of entry and industry-specific and region-specific trends in productivity. Since our industry dummies are at a more aggregate level than our measures of foreign entry rates and our controls for industry growth may not fully capture changes in total factor productivity, there could still be scope for endogeneity of the mode of entry at the 5-digit industry level. The same is true for endogeneity at the regional level.

Ideally, we would want an instrument correlated with greenfield entry but not correlated with acquisition entry and productivity. As it is difficult to think of such an instrument, we follow a different route to investigate whether endogeneity in the mode of entry decision could
explain the opposite effects of greenfield and acquisition entry. If our results are driven by endogeneity in the mode of entry, the results would be generated by greenfield and acquisition entry occurring in different industry-year/region-year cells. To check this possibility at the industry level, we drop observations in 5-digit industry-year cells where we observe only one mode of entry. At the region level we drop labour market region-year cells where we observe only one mode of foreign entry. The results of these two checks are displayed in the last two columns of Table 3. We are still able to identify a negative effect on the productivity of domestic plants following foreign greenfield entry both at the industry and at the region level, and a positive effect following acquisition entry at industry level. As in some previous regressions we also identify a negative effect of foreign acquisitions on domestic firms in the same region. This indicates that our results cannot be explained by endogeneity between the mode of foreign entry and industry or regional performance.

**Measurement of productivity and the mode of foreign entry**

Table 4 presents the results for a number of further robustness checks where we vary the measurement of productivity and the estimation method. The regressions are all variations of equation (2) as reported in the last column of Table 2. In the first column, we report the results of a more general specification of equation (2) in which we allow the coefficients on inputs to vary across 3-digit industries by interacting the inputs with industry dummies. Our specification in Table 2 constrains the input elasticities to be the same for all manufacturing industries, but technological differences between industries may bias our estimates of the effects of foreign entry. The results in column 1 of Table 4 do not suggest that this is the case, as the effects of foreign entry and acquisitions, and the remaining change in foreign presence are very similar to our original results both at the industry and at the region level.

Production function estimation has been shown to yield poor results when important unobservables that vary both across plants and over time, such as productivity shocks, are omitted. This suggests that differencing and controlling for plant fixed effects may yield poor estimates of input use and, moreover, it may not be sufficient to render the error term $\varepsilon_{it}$ in equation (1) white noise. Olley and Pakes (1996) show that such unobservable shocks can be proxied for by
Table 4: Robustness to different specifications

<table>
<thead>
<tr>
<th>Dep. var.</th>
<th>∆ ln $Y_{it}$</th>
<th>∆ ln TFP$_{it}$</th>
<th>∆ TFP$_{it}$</th>
<th>ln $Y_{it}$</th>
<th>∆$<em>{t-3}$ ln $Y</em>{it}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>3-digit levpet</td>
<td>residuals</td>
<td>translog</td>
<td>fixed effects</td>
<td>3-year differences</td>
</tr>
<tr>
<td>$G_{it}$</td>
<td>-.100 (.077)</td>
<td>-.145 (.078)</td>
<td>-.074 (.071)</td>
<td>-.100 (.080)</td>
<td></td>
</tr>
<tr>
<td>$G_{i,t-1}$</td>
<td>-.194 (.068)**</td>
<td>-.142 (.073)**</td>
<td>-.107 (.065)</td>
<td>-.278 (.078)**</td>
<td></td>
</tr>
<tr>
<td>$G_{i,t-2}$</td>
<td>.005 (.080)</td>
<td>.032 (.082)</td>
<td>.027 (.068)</td>
<td>-.130 (.076)**</td>
<td></td>
</tr>
<tr>
<td>$A_{it}$</td>
<td>.004 (.017)</td>
<td>.003 (.018)</td>
<td>-.000 (.017)</td>
<td>.004 (.018)</td>
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</tr>
<tr>
<td>$A_{i,t-1}$</td>
<td>.065 (.020)**</td>
<td>.075 (.021)**</td>
<td>.051 (.018)**</td>
<td>.045 (.028)</td>
<td></td>
</tr>
<tr>
<td>$A_{i,t-2}$</td>
<td>.027 (.022)</td>
<td>.027 (.022)</td>
<td>.043 (.021)*</td>
<td>.162 (.028)**</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{it}$</td>
<td>.017 (.021)</td>
<td>.028 (.027)</td>
<td>.010 (.019)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{i,t-1}$</td>
<td>-.051 (.022)*</td>
<td>-.044 (.022)**</td>
<td>-.038 (.019)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{i,t-2}$</td>
<td>.029 (.021)</td>
<td>.034 (.023)</td>
<td>.020 (.018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_{it}$</td>
<td></td>
<td></td>
<td></td>
<td>.043 (.021)*</td>
<td></td>
</tr>
<tr>
<td>$F_{i,t-1}$</td>
<td></td>
<td></td>
<td></td>
<td>-.091 (.022)**</td>
<td></td>
</tr>
<tr>
<td>$F_{i,t-2}$</td>
<td></td>
<td></td>
<td></td>
<td>.028 (.022)</td>
<td></td>
</tr>
<tr>
<td>$G_{R,t}$</td>
<td>.106 (.144)</td>
<td>.058 (.147)</td>
<td>.121 (.137)</td>
<td>-.108 (.161)</td>
<td></td>
</tr>
<tr>
<td>$G_{R,t-1}$</td>
<td>-.497 (.180)**</td>
<td>-.456 (.175)**</td>
<td>-.302 (.171)**</td>
<td>-.516 (.188)**</td>
<td></td>
</tr>
<tr>
<td>$G_{R,t-2}$</td>
<td>.017 (.168)</td>
<td>.086 (.167)</td>
<td>-.246 (.164)</td>
<td>-.638 (.193)**</td>
<td></td>
</tr>
<tr>
<td>$A_{R,t}$</td>
<td>-.034 (.023)</td>
<td>-.036 (.024)</td>
<td>-.034 (.022)</td>
<td>-.049 (.026)**</td>
<td></td>
</tr>
<tr>
<td>$A_{R,t-1}$</td>
<td>.008 (.027)</td>
<td>.008 (.028)</td>
<td>.043 (.026)</td>
<td>-.000 (.049)</td>
<td></td>
</tr>
<tr>
<td>$A_{R,t-2}$</td>
<td>-.037 (.027)</td>
<td>-.033 (.028)</td>
<td>-.032 (.025)</td>
<td>-.031 (.050)</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{R,t}$</td>
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<td>.002 (.039)</td>
<td>.002 (.035)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{R,t-1}$</td>
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<td>.017 (.041)</td>
<td>.006 (.036)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{R,t-2}$</td>
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<td>.022 (.041)</td>
<td>.051 (.038)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_{R,t}$</td>
<td></td>
<td></td>
<td></td>
<td>-.047 (.042)</td>
<td></td>
</tr>
<tr>
<td>$F_{R,t-1}$</td>
<td></td>
<td></td>
<td></td>
<td>.005 (.047)</td>
<td></td>
</tr>
<tr>
<td>$F_{R,t-2}$</td>
<td></td>
<td></td>
<td></td>
<td>-.042 (.043)</td>
<td></td>
</tr>
<tr>
<td>$G_{R,t+(t-1)+(t-2)}$</td>
<td></td>
<td></td>
<td>-.192 (.067)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$A_{R,t+(t-1)+(t-2)}$</td>
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<td></td>
<td>.075 (.017)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta_{t-3}F_{R,t}$</td>
<td></td>
<td></td>
<td>-.005 (.023)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$G_{R,t+(t-1)+(t-2)}$</td>
<td></td>
<td></td>
<td>-.321 (.099)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$A_{R,t+(t-1)+(t-2)}$</td>
<td></td>
<td></td>
<td>-.064 (.023)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta_{t-3}F_{R,t}$</td>
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<td></td>
<td>-.026 (.041)</td>
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</tr>
<tr>
<td>R² adj.</td>
<td>.81</td>
<td>.07</td>
<td>.08</td>
<td>.89</td>
<td>.85</td>
</tr>
<tr>
<td>N</td>
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<td>85892</td>
<td>85900</td>
<td>71284</td>
</tr>
<tr>
<td>Plants</td>
<td>7363</td>
<td>7363</td>
<td>7363</td>
<td>7363</td>
<td>6533</td>
</tr>
</tbody>
</table>

Note: Coefficients on inputs, competition variables and industry growth as outlined in equation 2 and as appropriate for the type of regression not displayed. Year dummies, region dummies, 3-digit industry dummies, and 2-digit - year interaction terms included in all regressions. ***, *, (·) indicate significance at 1%, 5%, and 10% respectively. Robust standard errors adjusted for clustering at the plant level in round parentheses.
investment behavior, on the assumption that these shocks influence current investment, but - since investment takes time - not current output. Their approach requires that plants undertake a positive amount of investment, which is not the case for about 25% of the observations in our sample. Instead, Levinsohn and Petrin (2003) propose using intermediate inputs rather than investment to address the underlying simultaneity problem. We use the Levinsohn-Petrin method to estimate total factor productivity (TFP) as the residuals of a Cobb-Douglas production function at the 2-digit level.\textsuperscript{16} In the second column we use the first difference of this TFP measure as our dependent variable when estimating equation (2), omitting the inputs on the right hand side. In the third column, our measure of productivity is a superlative index of TFP derived from a flexible translog specification of the production technology, see Caves et al. (1982a, 1982b).\textsuperscript{17} Both the results in columns 2 and 3 are similar to our original specification. Note, however, that in contrast to our analysis so far the TFP measures in columns 2 and 3 impose constant returns to scale.

In our main specification we eliminate unobserved time invariant effects by taking first differences. An alternative method is to use fixed effects estimation (within-transformation) as displayed in the fourth column of Table 4. The effect from greenfield entry is also negative both at industry and region level. At the industry level the effect of acquisitions is positive, while the effect of preexisting foreign presence remains ambiguous.

First differencing is known to introduce biases by exacerbating measurement error in the regressors. Longer time differences tend to reduce this problem (Griliches and Hausman, 1986), therefore we report the results from three-year differences in the last column of Table 4. To make our entry measures consistent with the longer differences, we include in the $G_{t,(t+(t-1)+(t-2)}$ measure all foreign greenfield entrants that entered either in the current year or in the previous two years. The acquisition measure is defined in a similar way for plants that were acquired by foreign owners in year $t$, $t - 1$, or $t - 2$. The change in remaining foreign presence is then the 3-year difference in foreign presence minus the 3-year entry rates. The results from this specification confirm our earlier results, greenfield entry has a negative effect on the productivity

\textsuperscript{16}In the absence of an appropriate deflator we use the share of energy in material use to proxy for unobserved productivity shocks.

\textsuperscript{17}This index is used by Aghion et al. (2009). Details on the construction of this index can be found in the Appendix.
of domestic plants both in the same industry and in the same region. Acquisition entry has a positive effect on the productivity of domestic plants in the same industry and here we also get a negative effect from acquisition entry on domestic plants in the same region.

6 Discussion

The main message from the results presented in Section 5 can be summarised as follows: recent greenfield entry in the same sector has a negative impact on the productivity of domestic plants, while recent acquisition entry has a positive effect. Recent greenfield entry in the same region has a negative effect, and this is also the case, but to a smaller extent, for acquisition entry in the same region in some of our specifications. The cumulative effect of remaining changes in preexisting foreign presence is never significant in our specifications.

Turning to the regional entry rates first, our results indicate that any positive effects of knowledge diffusion from foreign entrants in the same region must be dominated by another negative effect. Clearly, these entry rates do not capture product market competition since the industry entry rates are included in the same regression. As capital goods and intermediate inputs are more easily sourced from abroad, the most likely candidate for the negative effect is competition in the labour market. The literature on labour mobility suggests that domestic plants benefit from hiring employees that have experience in multinational firms (Görg and Strobl, 2005; Poole, 2009; Balsvik, forthc.18). When key employees move in the other direction this may well work to the detriment of the domestic firms. Aitken et al. (1996) argue that the productivity of the domestic firms may decrease if foreign firms poach the best workers from domestic firms this may reduce the productivity of the domestic firms. In addition, an increased demand for skilled labour following foreign entry may increase labour costs, and hence reduce productivity (Barry et al., 2005).

Information on the skill composition of employees would help to shed some light on these issues, unfortunately our data set does not contain this information. There is, however, evidence that workers in foreign-owned firms are positively selected relative to workers in domestically

18There is also work on spillovers associated with the mobility of scientists, see among others Song et al. (2003) and Møen (2005).
owned plants (Balsvik, forthc.). There is also evidence that foreign-owned firms in Norwegian manufacturing pay higher wages (Balsvik and Haller, forthc.). Norway is also a small country with relatively low unemployment which makes it likely that the cost of losing key employees to foreign multinationals reduces productivity in the domestic firms affected. Given that greenfield entrants need to hire much more staff than acquisition entrants in the initial years after entry, it appears reasonable that the negative effect of competition at the labour market region level is largest from greenfield entry.

Turning next to our findings on industry entry rates: the positive effect on domestic productivity from acquisition entry is consistent with the idea of positive knowledge spillovers. While foreign acquisitions increase competition in the longer run, in the short run the domestic plants seem to be able to turn the change in ownership structure in the industry to their advantage. This could be because the acquired plants themselves are hampered by in-house restructuring after a takeover. Labour turnover associated with the change in ownership in the case of foreign acquisitions may provide a pool of employees to domestic firms who serve as a channel for knowledge diffusion. The negative effect from greenfield entry could then be due to either competition in the labour market as discussed above and/or a negative competition effect in the product market. Several spillover studies have found significant negative effects of foreign presence in the same sector on domestic productivity. The most prominent explanation proposed so far is that of a negative competition effect through market stealing (Aitken and Harrison, 1999), whereby domestic firms lose market shares to foreign-owned firms and thus move up their average cost curves. While our regressions control for changes in market share and other competition variables, competition from foreign entrants may still force domestic firms up their average cost curves if they are unable to fully adjust their input use in the short run. In the following illustrative regressions, we concentrate on product market competition and therefore drop the regional entry rates.

The two modes of foreign entry have a different impact on market structure, simply because greenfield entry adds additional production capacity while a foreign acquisition merely changes the name of an existing market share. As a result, market stealing effects should primarily come from foreign-owned firms that are new to the market rather than from foreign acquisitions. The
Table 5: Effect of domestic entry on domestic productivity and effect of foreign entry on industries split by median export intensity

<table>
<thead>
<tr>
<th>Dep. var.</th>
<th>Check</th>
<th>( \Delta \ln Y_{it} )</th>
<th>( \Delta \ln Y_{it} )</th>
<th>( \Delta \ln Y_{it} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>domestic entry</td>
<td>industry-level export intensity</td>
<td>above median</td>
</tr>
<tr>
<td>( DE_{i,t} )</td>
<td>-0.005 (0.031)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( DE_{i,t-1} )</td>
<td>-0.030 (0.028)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( DE_{i,t-2} )</td>
<td>-0.032 (0.030)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( G_{t} )</td>
<td>-0.165 (0.092)***</td>
<td>0.111 (0.151)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( G_{t-1} )</td>
<td>-0.171 (0.082)*</td>
<td>-0.189 (0.183)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( G_{t-2} )</td>
<td>0.017 (0.094)</td>
<td>-0.071 (0.178)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( A_{t} )</td>
<td>0.016 (0.028)</td>
<td>-0.042 (0.026)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( A_{t-1} )</td>
<td>0.109 (0.036)**</td>
<td>0.045 (0.027)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( A_{t-2} )</td>
<td>0.039 (0.037)</td>
<td>0.053 (0.027)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta F_{t} )</td>
<td>0.100 (0.037)**</td>
<td>-0.019 (0.026)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta F_{t-1} )</td>
<td>-0.055 (0.038)</td>
<td>-0.058 (0.027)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta F_{t-2} )</td>
<td>0.076 (0.039)*</td>
<td>0.009 (0.027)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{adj R}^2 )</td>
<td>0.78</td>
<td>0.79</td>
<td>0.78</td>
<td></td>
</tr>
</tbody>
</table>

| \( \sum DE_{it} \) [p-value] | -0.066 [0.053] |  |  |  |
| \( \sum G_{t} \) [p-value] | -0.318 [0.009] | -0.149 [0.526] |  |  |
| \( \sum A_{t} \) [p-value] | 0.164 [0.000] | 0.075 [0.051] |  |  |
| \( \sum \Delta F_{t} \) [p-value] | 0.120 [0.022] | -0.068 [0.130] |  |  |

Note: Unreported regressors are \( \Delta \ln K_{it} \), \( \Delta \ln M_{it} \), \( \Delta \ln H_{it} \), \( \Delta MS_{i,t-2} \), \( \Delta PM_{i,t-2} \), \( \Delta CR5_{i,t} \) as well as year dummies, region dummies, 3-digit industry dummies, and 2-digit year interaction terms. Columns 2 and 3 also control for \( \Delta \ln (Y_{it} - Y_{it}) \) and \( \Delta \ln (L_{it} - L_{it}) \). ***,*,(+) indicate significance at 1%, 5%, and 10% respectively. Robust standard errors adjusted for clustering at the plant level in round parentheses. \( DE_{it} \) in column 1 is the employment-weighted entry rate of domestic plants at the 5-digit industry level.

The negative productivity effect of greenfield entry on domestic plants could of course be an effect of entry in general and need not be specific to foreign greenfield entry. We check this by estimating equation (2) using employment-weighted entry rates of domestic plants instead of our measures of foreign entry (see the Appendix for variable definitions). As can be seen from the first column of Table 5, none of the estimated coefficients on domestic entry are significant.

An explanation for the different effects of foreign and domestic entry is that domestic entry is part of a regular turnover process in an industry, while foreign greenfield entry is the result of large and successful firms expanding abroad. Thus, the market stealing effect from foreign entrants is likely to be stronger than from domestic entrants.
If the negative effect from greenfield entry is a result of market stealing, firms in industries producing mainly for the domestic market should be affected more than firms that sell a substantial share of their output in foreign markets. To examine this possibility we split the sample at the median export intensity which in our sample is 22.2% (for a definition and data used in the construction of the export intensity measure please consult the Appendix). The results of these regressions are displayed in columns 2 and 3 of Table 5. Foreign acquisitions have a positive effect irrespective of the export intensity. Instead the negative effect from greenfield entry on domestic firms in the same industry affects only firms in industries that are focussed mainly on the domestic market. Since our dataset does not contain plant-level output prices, we are unable to determine whether this decline in productivity is primarily due to competition lowering output prices or to reducing the volume of production.

7 Conclusions

Our aim in this paper is to bring new insights to the spillover debate by distinguishing between new and existing foreign-owned firms, and moreover between different modes of foreign entry. In our panel of Norwegian manufacturing plants, an overall change in foreign presence at the industry level has a small positive impact on the productivity of domestic plants, while foreign presence in the same region has a less precisely measured negative effect on the productivity of domestic plants in that region. When decomposing the measure of industry foreign presence into new and existing foreign firms, we find opposite effects from greenfield entrants and foreign acquisitions. The impact of greenfield entry on the productivity of domestic plants in the same industry is negative, while we find a positive effect from foreign acquisitions. Foreign entry at the regional level has a negative effect on the productivity of domestic plants in the same labour market region, strongest for greenfield entrants.

Foreign entry through greenfield investment and acquisition of domestic firms are likely to differ both in their effect on market structure and in their effect on labour demand. The estimated effect of foreign acquisitions on the productivity of domestic plants is consistent with spillovers from foreign-owned plants through knowledge diffusion and positive competition effects. Greenfield entrants add additional production capacity and are therefore more likely
to steal market shares from domestic plants than multinational firms that enter the domestic market by acquisition of domestic firms. In addition, greenfield entrants must find employees for their new production facilities, and may thus ‘poach’ key employees from domestic plants. Competition in the labour market is likely to occur also at the regional level, as foreign-owned plants may not only hire workers from existing plants in the same industry but also in the same labour market region. Also plants that are acquired by foreign owners may restructure or expand their employment, and hence may also contribute to labour stealing from domestic plants, but at a smaller scale than greenfield entrants. Both of these effects contribute towards explaining our results of an opposite effect of foreign acquisitions and greenfield entry on the productivity of domestic firms. An interesting avenue for future research could, therefore, be to examine these effects in more detail using linked employer-employee data.

References


[39] Poole, J.P. (2009), ‘Knowledge Transfers from Multinational to Domestic Firms: Evidence from Worker Mobility’, mimeo, University of California, Santa Cruz.


## A Appendix

Table 6: Summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
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</thead>
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<td><strong>Levels</strong></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$\ln Y_{it}$</td>
<td>9.521</td>
<td>1.29</td>
<td>2.565</td>
<td>15.311</td>
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<td>$\ln K_{it}$</td>
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<td>1.269</td>
<td>1.792</td>
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<td>85900</td>
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<td>$\ln M_{it}$</td>
<td>8.68</td>
<td>1.49</td>
<td>1.39</td>
<td>14.49</td>
<td>85900</td>
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<td>$\ln H_{it}$</td>
<td>3.365</td>
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<td>-3.937</td>
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<td>85900</td>
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<td>0.044</td>
<td>0</td>
<td>0.892</td>
<td>85900</td>
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<td>$PM_{it}$</td>
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<td>0.123</td>
<td>-0.778</td>
<td>0.523</td>
<td>85898</td>
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<td>$CR5_{it}$</td>
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<td>0.261</td>
<td>0.091</td>
<td>1</td>
<td>2791</td>
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<td>$FP_{it}$</td>
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<td>2791</td>
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<td>0</td>
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<td>0.065</td>
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<td>2791</td>
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<td>$G_{Rt}$</td>
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<td>0.003</td>
<td>0</td>
<td>0.044</td>
<td>2791</td>
</tr>
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<td>$A_{Rt}$</td>
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<td>0.014</td>
<td>0</td>
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<td>2791</td>
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<td><strong>Differences</strong></td>
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<td></td>
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<tr>
<td>$\Delta \ln Y_{it}$</td>
<td>-0.006</td>
<td>0.351</td>
<td>-6.203</td>
<td>5.308</td>
<td>85900</td>
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<td>$\Delta \ln K_{it}$</td>
<td>0.027</td>
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<td>-4.395</td>
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<td>$\Delta \ln M_{it}$</td>
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<td>0.46</td>
<td>-7.014</td>
<td>6.791</td>
<td>85900</td>
</tr>
<tr>
<td>$\Delta \ln H_{it}$</td>
<td>-0.025</td>
<td>0.374</td>
<td>-8.066</td>
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<tr>
<td>$\Delta MS_{it}$</td>
<td>0</td>
<td>0.011</td>
<td>-0.684</td>
<td>0.688</td>
<td>85900</td>
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<tr>
<td>$\Delta PM_{it}$</td>
<td>-0.005</td>
<td>0.12</td>
<td>-1.119</td>
<td>1.004</td>
<td>85897</td>
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<td>$\Delta ln(Y_{it} - Y_{it})$</td>
<td>0.009</td>
<td>0.189</td>
<td>-4.524</td>
<td>4.594</td>
<td>85900</td>
</tr>
<tr>
<td>$\Delta ln(L_{it} - L_{it})$</td>
<td>-0.017</td>
<td>0.167</td>
<td>-4.1</td>
<td>4.256</td>
<td>85900</td>
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<td>$\Delta FP_{it}$</td>
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<td>0.081</td>
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<td>0.049</td>
<td>-0.684</td>
<td>0.495</td>
<td>2791</td>
</tr>
<tr>
<td>$\Delta FP_{Rt}$</td>
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<td>0.016</td>
<td>-0.064</td>
<td>0.144</td>
<td>2791</td>
</tr>
<tr>
<td>$\Delta F_{Rt}$</td>
<td>-0.005</td>
<td>0.009</td>
<td>-0.064</td>
<td>0.053</td>
<td>2791</td>
</tr>
</tbody>
</table>

Note: Summary statistics for industry level variables are reported for 5-digit industry-year cells.
Table 7: Individual and selected greenfield, acquisition and change in foreign presence coefficients

<table>
<thead>
<tr>
<th></th>
<th>Individual coefficients</th>
<th>R² adj.</th>
<th>Contemporaneous</th>
<th>First lags only</th>
<th>Second lags only</th>
</tr>
</thead>
<tbody>
<tr>
<td>G_{It}</td>
<td>-.101 (.073)</td>
<td>.79</td>
<td>-.091 (.074)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G_{It-1}</td>
<td>-.201 (.069)**</td>
<td>.79</td>
<td>- .234 (.070)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G_{It-2}</td>
<td>.008 (.082)</td>
<td>.79</td>
<td>.015 (.083)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_{It}</td>
<td>.002 (.018)</td>
<td>.79</td>
<td>.003 (.018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_{It-1}</td>
<td>.075 (.022)**</td>
<td>.79</td>
<td>.080 (.022)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_{I,t-2}</td>
<td>.031 (.022)</td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔF_{It}</td>
<td>.032 (.021)</td>
<td>.79</td>
<td>.030 (.022)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔF_{I,t-1}</td>
<td>-.059 (.023)*</td>
<td>.79</td>
<td>-.063 (.023)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔF_{I,t-2}</td>
<td>.052 (.022)*</td>
<td>.79</td>
<td>.051 (.023)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G_{Rt}</td>
<td>-.065 (.137)</td>
<td>.79</td>
<td>-.090 (.138)</td>
<td>-.386 (.158)*</td>
<td>-.050 (.153)</td>
</tr>
<tr>
<td>G_{R,t-1}</td>
<td>-.405 (.156)**</td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G_{R,t-2}</td>
<td>-.082 (.152)</td>
<td>.79</td>
<td></td>
<td>-.050 (.153)</td>
<td></td>
</tr>
<tr>
<td>A_{Rt}</td>
<td>-.033 (.025)</td>
<td>.79</td>
<td>-.034 (.025)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_{R,t-1}</td>
<td>.003 (.028)</td>
<td>.79</td>
<td>.000 (.028)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_{R,t-2}</td>
<td>-.040 (.028)</td>
<td>.79</td>
<td>-.040 (.028)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔF_{Rt}</td>
<td>-.042 (.041)</td>
<td>.79</td>
<td>-.047 (.041)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔF_{R,t-1}</td>
<td>.029 (.041)</td>
<td>.79</td>
<td>.019 (.041)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔF_{R,t-2}</td>
<td>.053 (.041)</td>
<td>.79</td>
<td>.050 (.042)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R² adj.</td>
<td></td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Note: Results in the first column are for one regression per row where only the respective foreign presence variable is included in equation 2. Dependent variable is Δ ln Y_{it}. Unreported regressors are Δ ln K_{it}, Δ ln M_{it}, Δ ln H_{it}, Δ MS_{I,t-2}, Δ PM_{I,t-2}, Δ CR5_{I,t}, Δ ln(Y_{It} - Y_{it}), Δ ln(L_{It} - L_{it}) as well as year dummies, region dummies, 3-digit industry dummies, and 2-digit - year interaction terms. ***, *, (**) indicate significance at 1%, 5%, and 10% respectively. Robust standard errors adjusted for clustering at the plant level in round parentheses.
Table 8: Greenfield, acquisition and change in foreign presence coefficients separate for each type of entry

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$G_{It}$</td>
<td>-0.086 (.073)</td>
<td></td>
</tr>
<tr>
<td>$G_{I,t-1}$</td>
<td>-0.193 (.071)**</td>
<td></td>
</tr>
<tr>
<td>$G_{I,t-2}$</td>
<td>0.012 (.082)</td>
<td></td>
</tr>
<tr>
<td>$A_{It}$</td>
<td>0.002 (.018)</td>
<td></td>
</tr>
<tr>
<td>$A_{I,t-1}$</td>
<td>0.075 (.022)**</td>
<td></td>
</tr>
<tr>
<td>$A_{I,t-2}$</td>
<td>0.031 (.022)</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{It}$</td>
<td>0.025 (.021)</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{I,t-1}$</td>
<td>-0.049 (.022)*</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{I,t-2}$</td>
<td>0.045 (.022)*</td>
<td></td>
</tr>
<tr>
<td>$G_{R,t}$</td>
<td>-0.002 (.149)</td>
<td></td>
</tr>
<tr>
<td>$G_{R,t-1}$</td>
<td>-0.402 (.175)*</td>
<td></td>
</tr>
<tr>
<td>$G_{R,t-2}$</td>
<td>-0.016 (.168)</td>
<td></td>
</tr>
<tr>
<td>$A_{R,t}$</td>
<td>-0.032 (.025)</td>
<td></td>
</tr>
<tr>
<td>$A_{R,t-1}$</td>
<td>0.002 (.028)</td>
<td></td>
</tr>
<tr>
<td>$A_{R,t-2}$</td>
<td>-0.039 (.028)</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{R,t}$</td>
<td>-0.043 (.040)</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{R,t-1}$</td>
<td>0.029 (.040)</td>
<td></td>
</tr>
<tr>
<td>$\Delta F_{R,t-2}$</td>
<td>0.055 (.041)</td>
<td></td>
</tr>
<tr>
<td>$R^2$ adj.</td>
<td>0.79</td>
<td></td>
</tr>
</tbody>
</table>

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Note: Dependent variable is $\Delta \ln Y_{it}$. Unreported regressors are $\Delta \ln K_{it}$, $\Delta \ln M_{it}$, $\Delta \ln H_{it}$, $\Delta MS_{i,t-2}$, $\Delta PM_{i,t-2}$, $\Delta CR5_{i,t}$, $\Delta \ln (Y_{it} - Y_d)$, $\Delta \ln (L_{it} - L_d)$ as well as year dummies, region dummies, 3-digit industry dummies, and 2-digit - year interaction terms. ***, *, and () indicate significance at 1%, 5%, and 10% respectively. Robust standard errors adjusted for clustering at the plant level in round parentheses.
Data and Variable Definitions

CR5_{lt}  Joint market share of the 5 largest plants in a 5-digit industry in terms of output relative to industry output.

DE_{it}  Domestic entry rate in 5-digit industry I. Defined as the total employment of domestic entrants (plants with below 20% foreign ownership) in the industry divided by the total employment of all domestic plants apart from plant i in the industry. If plant i is itself an entrant in year t its employment is also excluded from the numerator of the domestic entry rate.

export intensity  Export intensity is defined at the 3-digit industry level as the total exports of firms in the industry divided by the total output of firms in the industry. This is based on firm-level export data from 1996-1998. We use the average export intensity for each sector in these years as a proxy for the whole period of analysis.

H_{it}  Number of person hours in the plant. Since only blue-collar hours are reported prior to 1983, and only total hours from 1983, we estimate total hours before 1983 by using information on the blue-collar share of the total wage bill. Rented labour hours are calculated from the costs of rented labour using the calculated average wage for own employees.

K_{it}  Our estimate of capital services uses the following aggregation:

\[ K_{it} = R_{it} + (0.07 + \delta^m)V_{it}^m + (0.07 + \delta^b)V_{it}^b, \]

where \( R_{it} \) is the cost of rented capital in the plant, \( V_{it}^m \) and \( V_{it}^b \) are the estimated values of machinery and buildings at the beginning of the year, \( \delta^m = 0.06 \) and \( \delta^b = 0.02 \) are the depreciation rates that we use. We take the rate of return to capital to be 0.07. The estimated values of buildings and machinery are obtained from information on fire insurance values. To reduce noise and avoid discarding too many observations with missing fire insurance values, we smooth these values using the perpetual inventory method. Fire insurance values are not recorded after 1995, thus from 1996 we estimate capital values by adding investments and taking account of depreciation. Where possible, we also use
estimates of firm level capital values (distributed to the plant level according to employment shares) as starting values for plants with entry after 1995. These capital values are obtained from recent work to improve on capital estimates in Norwegian manufacturing (see Raknerud et al. 2007). We experimented with allocating sectoral capital stock data from the National Accounts to the plant level based on the plant’s share of energy use. Basing the start values for capital on the plant’s shares in industry capital stock combined with plant investment data does not alter our results qualitatively. We use separate price deflators for investment in buildings and machinery obtained from Statistics Norway. The aggregation level for the price deflators is according to the sector classification used in the National Accounts, which is somewhere in between the 2- and 3-digit ISIC level.

$L_{it}$ Plant employment.

$M_{it}$ Total cost of materials used. We subtract the included rented labour and capital and allocate them to the labour and capital measures respectively. We use an input price deflator obtained from Statistics Norway. The aggregation level for the price deflator is according to the sector classification used in the National Accounts, which is somewhere in between the 2- and 3-digit ISIC level.

$MS_{it}$ Plant output as a share of 5-digit industry output.

$PM_{it}$ Output less material and wage costs divided by output.

$\Delta TFP_{it}$ The measure of TFP is derived from a flexible translog specification of the production technology.

$$\Delta TFP_{it} = \Delta \ln Y_{it} - \sum_{z=M,K,H} \tilde{\alpha}_{it}^z \Delta \ln x_{it}^z,$$

where $x_{it}^z$ is the quantity used of factor $z$ in plant $i$ at time $t$. The Divisia share $\tilde{\alpha}_{it}^z$ is defined as $\tilde{\alpha}_{it}^z = (\alpha_{it}^z + \alpha_{it}^z -1)/2$ where $\alpha_{it}^z$ is the cost share of factor $z$ relative to total output value $Y$ in plant $i$ at time $t$. We impose constant returns to scale. Since there could be substantial noise in the observed factor shares, $\alpha_{it}^z$, we apply a smoothing procedure proposed by Harrigan (1997). Assuming a translog production technology, constant returns to scale (CRS), and standard market-clearing conditions, $\alpha_{it}^z$ can be
expressed as follows:

\[ \alpha_{it} = \nu_i + \varphi_{It} + \sum_{z=H,M} \omega_{Ht} \ln \left( \frac{x_{Ht}^z}{x_{Mt}^z} \right) \] (6)

where \( \nu_i \) is a plant-specific constant, \( \varphi_{It} \) an industry-time-specific constant and capital use is normalised to impose CRS. If the observed factor shares deviate from the left-hand side of this equation by an i.i.d. measurement error term, then the parameters can be estimated by separate fixed effects panel data regressions for each industry \( I \). We estimate equation (6) separately for each 3-digit ISIC industry, and use the fitted values from (6) as the factor shares in the calculation of (5).

\( Y_{it} \) Gross production value net of sales taxes and subsidies. Deflated using an output price deflator obtained from Statistics Norway with a level of aggregation somewhere in between the 2- and 3-digit ISIC level.